

A REVISION OF SOME UPPER DEVONIAN FORAMINIFERA FROM WESTERN AUSTRALIA

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ABSTRACT. Arenaceous foraminifera described by Crespin (1961) from the Upper Devonian Virgin Hills and Gogo Formations of the Fitzroy Basin of Western Australia are revised. Four genera and eight species are recognized; these include *Oxinoxis* Gutschick 1962 and *Sorosphaeroidea* Stewart and Lampe 1947, which were previously recorded only from the Middle Palaeozoic of the United States. The similarity of the fauna to Upper Devonian foraminiferal faunas in the United States and Europe is described.

Several new occurrences of foraminifera are reported from the Silurian and Devonian of New South Wales, Victoria, and Tasmania.

IN 1964–5, we had the opportunity to collect from the Palaeozoic rocks of Victoria, New South Wales, and Tasmania, south-eastern Australia, in order to assess the stratigraphic occurrence and geographic distribution of arenaceous foraminifera. A preliminary report on the Permian foraminifera of Tasmania has been made (Conkin and Conkin 1965*a*). We were able, through the kindness of Dr. Irene Crespin and Dr. D. J. Belford of the Bureau of Mineral Resources, Geology, and Geophysics at Canberra to study the types of Dr. Crespin's (1961) Upper Devonian foraminifera from the Virgin Hills and Gogo Formations of the Fitzroy Basin, Western Australia. It was discovered that some of the forms would require revision in the light of work done on arenaceous foraminifera after the completion of Dr. Crespin's work. With these revisions made, the relationships between this important fauna of Crespin (1961) and similar faunas in the United States and Europe can be more clearly seen.

Past work. Crespin (1961, p. 397) summarized the record of Devonian foraminifera in Australia as follows:

In 1918 Chapman described and figured three genera and five species of what he considered to be foraminifera from thin sections of a limestone of Devonian age from the Nemingha area, Tamworth, northern New South Wales. However, Wood (1957) stated that these forms were 'oolite grains more or less affected by dolomitization and by mechanical distortion'. Parr (*in* Teichert and Talent 1958) reported poorly preserved arenaceous foraminifera from Devonian rocks in the Buchan area, east Gippsland, Victoria.

Chapman (1933) described two species of foraminifera from the Silurian of Victoria, '*Trochammina bursaria*' and '*Hemigordius lilydalensis*'; the former is perhaps conspecific with *Thuramminoides sphaeroidalis* Plummer 1945, which may not be a foraminiferan, but possibly a radiolarian or spore-like body (Conkin, Conkin, and Canis 1968); the latter is an indeterminate arenaceous foraminiferan and certainly not the calcareous *Hemigordius* or even a siliceous replacement of *Hemigordius*.

Crespin's (1961) fauna, the first important foraminiferal fauna from the Devonian of Australia, contains four genera and eight species as revised in the present paper.

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Present work. Silurian and Devonian foraminifera were observed by us in the following states and stratigraphic horizons:

Tasmania, upper part of the Middle Devonian Point Hibbs Limestone at Point Hibbs: *Sorosphaeroidea* sp.

Victoria, east Gippsland, Devonian Pyramid Member of the Buchan Cave Limestone at Bindi: *Tolypammina* spp., *Sorosphaeroidea* sp., and *Hyperammina*? sp.

New South Wales, Yass-Taemas area, Devonian *Spirifer yassensis* beds: *Hyperammina* sp. and *Colonammina*? sp.

Victoria–New South Wales border area, Silurian Cowombat Formation at Cowombat Flat: *Hyperammina* sp., *Tolypammina* sp., and *Psammospaera*? sp.

The presence of these foraminifera in the Palaeozoic of Australia shows the need for further work on this group along the lines of Crespin (1958, 1961). We are in the process of describing these foraminifera from the Silurian and Devonian of Australia as well as making a detailed study of the magnificent arenaceous foraminiferal faunas from the Permian of Tasmania.

DISCUSSION OF GENERA

Saccammina Sars 1869. This genus consists of a simple agglutinated chamber with an aperture which may or may not have a short neck; as thus understood, *Saccammina* has been reported from Silurian to Recent.

Sorosphaeroidea Stewart and Lampe 1947 has a distinctive aperture which was not originally noticed by Stewart and Lampe or subsequently by Summerson (1958).

Oxinoxis Gutschick 1962, emended Conkin and Conkin 1964. The range of *Oxinoxis*, previously reported only from the United States, is upper Middle Devonian (middle and upper Hamiltonian) to Lower Mississippian (Kinderhookian and lower Osagean). Middle Devonian forms are almost exclusively single chambered and small. Upper Devonian forms are single to multiple chambered, and small to large. Kinderhookian and lower Osagean forms are generally much like the Upper Devonian, although there is in addition a distinct single chambered species of *Oxinoxis* in the Kinderhookian (Conkin, Conkin, and Canis 1968).

Tolypammina Rhumbler 1895. This attached genus ranges from Ordovician to Recent. Pre-Upper Devonian forms appear to wind or twist in a haphazard, disorganized manner, while some of the post-Middle Devonian forms wind, at least partially, in a more organized pattern. It is probable that the even more 'organized', but similar genus, *Ammonvertella* Cushman 1928, which apparently arose in the Kinderhookian, was derived from *Tolypammina*.

Hyperammina Brady 1878 is known from Ordovician to Recent. It is not present in Crespin's Upper Devonian fauna (1961), but occurs in the Silurian Cowombat Formation in the New South Wales–Victoria border area. The restricted generic definition of *Hyperammina* of Loeblich and Tappan (1964, p. C190) is not used. *Hyperammina* is employed in the sense of Brady 1878, as emended by Conkin (1954, 1961), and discussed by Conkin and Conkin (1965*b*, p. 211). It is basically a test with a free proloculus and

a free second chamber of more or less tubular shape, tapering and/or slightly constricted in some species. *Hyperammina* has great potential as a tool in stratigraphic palaeontology within the Palaeozoic; a beginning along this line has been made within the Lower Mississippian of the United States (Conkin 1961).

Psanimosphaera Schulze 1875 consists of a simple agglutinated spherical or globular chamber with no obvious aperture. It has been reported from Ordovician to Recent.

AGE OF THE VIRGIN HILLS FORMATION BASED ON FORAMINIFERA

Crespin (1961) reported only two specimens from that portion of the Upper Devonian of Western Australia which may be referred to the Gogo Formation. Most of her specimens came from the overlying Upper Devonian Virgin Hills Formation.

Considered strictly in terms of the known stratigraphic ranges of foraminiferal genera included, the Virgin Hills Formation could be of late Middle Devonian, Late Devonian, or Early Mississippian (Kinderhookian) age. *Sorosphaeroidea*, previously thought by us to be restricted to beds older than Mississippian, has now been discovered in rare numbers in the Kinderhookian McCraney Limestone of north-eastern Missouri. *Oxinoxis* has not been found below the upper Middle Devonian, but it ranges into the lower Osagean.

On a specific level, however, *Tolypammina helina*, with a test consisting of an initially coiled portion and a final extended portion, is an 'organized' kind of *Tolypammina* which is post-Middle Devonian in its stratigraphic occurrence. The foraminiferal fauna of the Louisiana Limestone (Upper Devonian) from Missouri and Illinois is the oldest fauna from which this type of *Tolypammina* has been described (Conkin and Conkin 1964) in North America; a similar species is found in the Upper Devonian of Germany (Blumenstengel 1961). Thus, *T. helina* places the Virgin Hills Formation in the Upper Devonian or Lower Mississippian, rather than the Middle Devonian.

SYSTEMATIC PALAEOONTOLOGY

The following observations are based on a study of Dr. Crespin's type specimens of Upper Devonian foraminifera at the Bureau of Mineral Resources, Geology and Geophysics, Canberra, A.C.T., Australia, and on a discussion of the fauna with Dr. Crespin. Text-fig. 1 is based on drawings made at that time and on photomicrographs taken subsequently and forwarded to us by Dr. D. J. Belford. Type numbers refer to Commonwealth Palaeontological Collection (CPC), and holotype and paratype designations are the original ones of Crespin (1961).

Family SACCAMMINIDAE

Genus SACCAMMINA M.Sars 1869

Saccammina glenisteri Crespin 1961

Plate 116, figs. 1-7.

1961 *Saccammina glenisteri* Crespin, pp. 401, 402, pl. 65, figs. 3-7.

The holotype (CPC 401; Pl. 116, figs. 1-3) has slit-like? aperture as figured by Crespin, and a few holes of secondary nature; the test, one grain thick, is composed of coarse grains of quartz in a fine-grained matrix; there is no evidence of attachment.

Paratype A (CPC 402; Pl. 116, figs. 6, 7) has a coarse-grained, subglobular test with an elongate, lunate aperture; there is no evidence of attachment.

Paratype B (CPC 403) has a rounded aperture; there is no evidence of attachment.

Paratype C (CPC 404; Pl. 116, figs. 4, 5) has a knob-like structure on the inside of the broken test which is like the structure found on the interior of the test and just below the aperture in *Sorosphaeroidea*, but which in this case may be secondarily formed.

Paratype D (CPC 405) consists of two globular tests attached to a *Tolypammina* fragment and composed of coarse grains of quartz; the apertures are indistinct, and the tests are smaller than the other types of this species; this specimen came from the Gogo Formation which underlies the Virgin Hills Formation from which the other specimens came. The identity of Paratype D is not certain since the tests are attached on a small surface and are thus not completely free.

Genus *SOROSPHAEROIDEA* Stewart and Lampe 1947

Sorosphaeroidea adhaerens (Crespin) 1961

Plate 116, figs. 8–11; text-fig. 1c

1961 *Sorosphaera adhaerens* Crespin, pp. 403, 404, pl. 66, figs. 1–5.

The holotype (CPC 406; Pl. 116, figs. 8, 9) consists of chambers which are attached to a *Tolypammina* fragment and the nature of the surface of attachment on the test (whether covered with a floor or open), is not known. Its reference to *Sorosphaeroidea* is uncertain, but probably correct.

Paratype A (CPC 407) consists of several chambers which are indistinct on one side, and attachment areas are somewhat obscure.

Paratype B (CPC 408; Pl. 116, figs. 10, 11; text-fig. 1c) possesses broad, flattened attachment scars (not originally figured), which are somewhat finer grained than the upper side of test; there is a definite aperture on the upper, unattached side of each chamber. A fragment of a *Tolypammina* is attached to the specimen.

Paratype C (CPC 409) is attached to a *Tolypammina* fragment, but the attached surface is not visible; an aperture is present on the upper side.

Paratype D (CPC 410) has an aperture on the upper unattached side; the attached side is not visible as it is fastened to a fragment of *Tolypammina*.

Remarks. Paratype B is definitely referable to *Sorosphaeroidea*; the other types have the attachment surface hidden, or it is obscure (Paratype A), but they probably belong to this genus also. We place this species in *Sorosphaeroidea* because of the large areas of attachment, and because the apertures generally are like those which we have found in the original types of *Sorosphaeroidea* of Stewart and Lampe; the aperture appears inverted, as if pushed through from the outside.

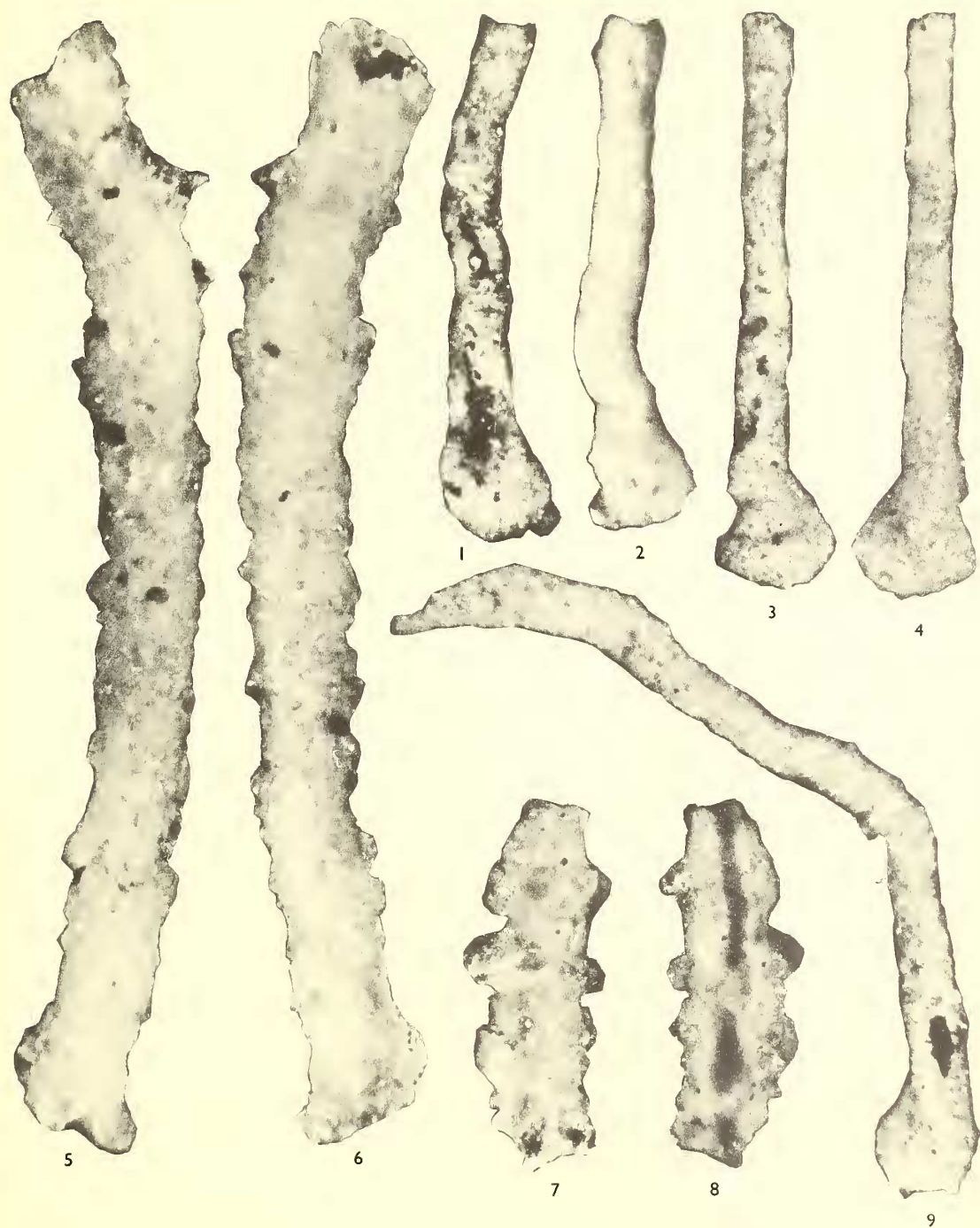
EXPLANATION OF PLATE 114

Figs. 1–4, 9. *Tolypammina devoniana* (Crespin) 1961. 1, Paratype A; basal, attached side showing rather large attachment scars, smoothly polished along the edges. 2, Paratype D, top view. 3, Side view of holotype showing attachment scar on the proloculus and small areas of attachment along the length of the second chamber. 4, Top view of holotype showing slight notch on proloculus. 9, Paratype E, top view showing break in test.

Figs. 5, 6. *Tolypammina*? sp. 5, Plesiotype (holotype of '*Rhabdammina virgata*' Crespin 1961), showing fragmentary nature and coarse-grained texture of the test. 6, Reverse side of same specimen; proloculus and aperture are not preserved.

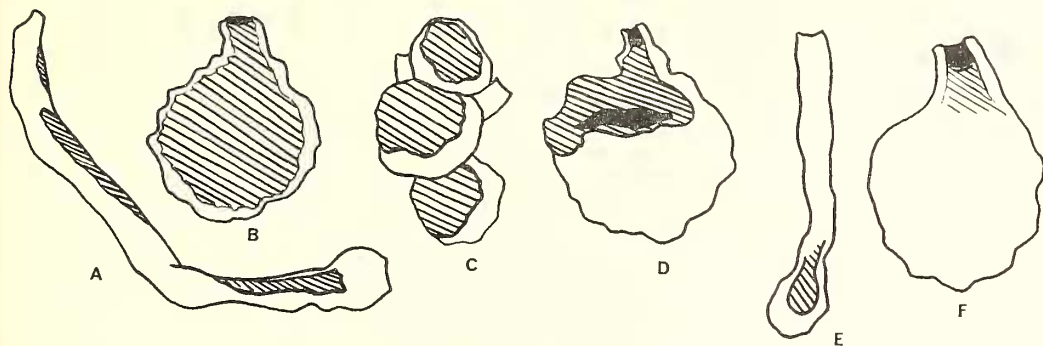
Figs. 7, 8. *Tolypammina* sp. 7, Plesiotype of '*Marsipella* sp.', Crespin 1961; top view of hemitubular fragment showing rough and coarse-grained test. 8, Basal view of same specimen showing attached lower surface.

All figures approximately $\times 105$.



CONKIN and CONKIN, Upper Devonian arenaceous foraminifera

The Middle Devonian forms of *Sorosphaeroidea* described by Stewart and Lampe (1947) and Summerson (1958) are more regularly shaped and arranged than the present forms.



TEXT-FIG. 1. Schematic drawings of attached sides of *Tolypammina devoniana* (A, E), *Oxinoxis ampullacea* (B, D, F), and *Sorosphaeroidea adhaerens* (C). All figures approximately $\times 50$. Hatched areas are flattened surfaces of attachment. Black arcs indicate openings into test. White areas are unattached portions of test.

Family REOPHACIDAE

Genus OXINOXIS Gutschick 1962, emend. Conkin and Conkin 1964

Oxinoxis ampullacea (Crespin) 1961

Plate 117, figs. 1–11; text-fig. 1B, D, F

1961 *Lagenammina ampullacea* Crespin, pp. 404, 405, pl. 66, figs. 6–8.

1961 *Colonammina imparilis* Crespin, pp. 405, 406, pl. 65, figs. 10–13.

1961 *Protonina* sp., Crespin, p. 404, pl. 65, fig. 8.

The holotype of '*Lagenammina*' *ampullacea* (CPC 412; Pl. 117, figs. 1–3) has a faint flattened attachment scar at the base, but otherwise the chamber is nearly spherical with a small apertural neck.

Paratype A of '*Lagenammina*' *ampullacea* (CPC 413; Pl. 117, fig. 11) is slightly flattened on the basal side, with a somewhat finer-grained texture there than on the upper side, but with some larger quartz grains studded on it; there is a small apertural neck.

Paratype B of '*Lagenammina*' *ampullacea* (CPC 414) has a rather prominent apertural neck with the basal side flattened; there is also a small, slightly roughened attachment area at the base of the chamber.

The holotype of '*Colonammina imparilis*' (CPC 415; Pl. 117, figs. 4–6; text-fig. 1D) consists of a nearly spherical chamber with a prominent wedge-shaped attachment scar forming a re-entrant into the test below the neck; the prominent apertural neck is hemitubular with the basal surface flattened and attached.

Paratype A of '*Colonammina imparilis*' (CPC 416) has a flattened attachment scar on the basal side which is finer grained than the unattached, upper, convex side; the prominent tubular apertural neck has no attachment scar.

Paratype B of '*Colonammina imparilis*' (CPC 417; Pl. 117, figs. 7, 8; text-fig. 1B) has a large basal attachment scar which is fine grained and has a polished lustre; the apertural neck is only partly attached on its basal side; the convex upper unattached side of the test is coarse grained.

Paratype C of '*Colonammina imparilis*' (CPC 418) is an obscure specimen; the apertural neck figured by Crespin (1961, pl. 65, fig. 13) appears to be part of another specimen and thus foreign to paratype C; the base of the test is flattened and has a prominent fine-grained attachment scar with a polished lustre; this specimen is not typical of the species, but does apparently belong to *O. ampullacea*.

'*Proteonina* sp.' (CPC 411; Pl. 117, figs. 9, 10; text-fig. 1F) is a compressed test with holes and depressions in the wall left after calcareous grains were leached out; the apertural neck is partly hemitubular and has a small attachment scar on the basal side at the apertural end, and after which the neck is tubular adjacent to the chamber, which is itself unattached; this specimen is from the Gogo Formation.

Remarks. The presence of an attachment scar on the chamber of the test and/or on the hemitubular to tubular apertural neck serves to place these specimens in *Oxinoxis*.

O. ampullacea differs from the type species *O. ligula* (Gutschick, Weiner, and Young 1961), which occurs in the Upper Devonian and Lower Mississippian in the United States, in having a more coarse-grained test and in being nearly twice as large as the single-chambered, more solidly-walled forms of *O. ligula*.

Family AMMODISCIDAE

Genus TOLYPAMMINA Rhumbler 1895

Tolypammina devoniana (Crespin) 1961

Plate 114, figs. 1-4, 9; text-figs. 1A, E

1961 *Hyperammina devoniana* Crespin, pp. 406, 407, pl. 64, figs. 1-6.

The holotype (CPC 419; Pl. 114, figs. 3, 4) has a proloculus which is asymmetrical, shaped rather like the head of a golf club, owing to a notch-like attachment scar on its basal surface where it joins the second chamber; this basal side of the proloculus is partially attached and there are attachment scars at irregular intervals and distances along the elongate second chamber.

EXPLANATION OF PLATE 115

Figs. 1-4. *Tolypammina helina* Crespin 1961. 1, Holotype, basal flattened and attached side of hemitubular test. 2, Top view of holotype showing proloculus, $2\frac{1}{2}$ planispiral whorls, and extended portion. 3, Paratype A, basal view showing the completely attached hemitubular test, and an early unsuccessful attempt to uncoil (after $1\frac{1}{2}$ planispiral whorls) with return to planispiral coiling for $1\frac{1}{4}$ whorls more before finally uncoiling. 4, Top view of paratype A, showing proloculus, rather obscure whorls, and extended portion.

FIGS. 5-8. *Tolypammina nexuosa* Crespin 1961. 5, Paratype B of *Tolypammina 'helina'*, top view. 6, Basal view of same specimen showing complete attachment of hemitubular test; no proloculus preserved. 7, Holotype of *Tolypammina nexuosa*, top view. 8, Basal view of holotype, showing attached side of test.

All figures approximately $\times 105$.

EXPLANATION OF PLATE 116

Figs. 1-7. *Saccammina glenisteri* Crespin 1961. 1, Holotype, upper apertural view, showing slit-like aperture in centre of test. 2, Basal view of holotype. 3, Side view of holotype. 4, Paratype C, broken test showing knob-like structure underneath the aperture on the interior of the test. 5, Exterior view of paratype C showing aperture in the centre of the test. 6, Paratype A, upper apertural view of test showing slit-like aperture in the centre of the test. 7, Basal view of paratype A.

Figs. 8-11. *Sorosphaeroidea adhaerens* (Crespin) 1961. 8, Holotype, view of aggregate of chambers shown by Crespin (1961, pl. 66, fig. 1) showing attachment to foreign body. 9, Reverse side of specimen. 10, Paratype B, upper unattached surface of test showing aperture piercing middle chamber and an attached fragment of *Tolypammina*. 11, Basal view of paratype B showing flattened chambers on attached side of test.

All figures approximately $\times 105$.



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